REMARKS

In response to the Official Action mailed on June 3, 2009, the application has been amended. No new matter has been added. Reconsideration of the rejections of the claims is respectfully requested in view of the above amendments and the following remarks.

Examiner Mehta and Examiner Ward are thanked for granting an interview on September 15, 2009 to discuss the present application. At the interview, the differences between the effects provided by a single-screw pump and a multiple-screw pump were discussed.

Page 2 of the Official Action pointed out an informality in Figure 1. As required by the Official Action, a corrected version of Figure 1 including the legend "Prior Art" is being submitted as part of this response.

On page 2 of the Official Action, claims 9 - 11, 14, and 15 were rejected under 35 USC 102(b) as anticipated by JP 62-259665. This rejection is respectfully traversed.

Claim 9 describes a wave soldering tank having a multiple-blade screw-type pump. JP 62-259665 does not disclose such an arrangement.

JP 62-259665 discloses a wave soldering apparatus having a pump 15 with a spiral screw 23 which is rotated by a motor 33 to

discharge molten solder from a nozzle 18. The text of JP 62-259665 does not describe the spiral screw 23 in detail except to state that it comprises a helical body 25 made of a titanium alloy plate which is wrapped around and welded to a rotating shaft 24 The text does not specify the number of blades formed on the spiral screw 23, but Figure 2 of JP 62-259665 clearly shows that the spiral screw 23 has only a single blade, i.e., it is formed by a single helix wrapped around the shaft 24. Although that helix has multiple turns, i.e., it spirals around the shaft 24 several times, there is only a single helix (blade) forming those turns. A comparison of Figure 2 of JP 62-259665 with Figure 1 of below-described U.S. Patent No. 7,165,933, which shows two helical screw blades 11 wrapped around a rotor 9, provides further evidence that the pump 15 of JP 62-259665 is only a single-blade screw pump.

Accordingly, as JP 62-259665 does not disclose a wave soldering tank having a multiple-blade screw-type pump, it does not disclose all the features of claim 9 and so cannot anticipate this claim. Claim 9 and claims 10, 11, 14, and 15 which depend from it are therefore allowable.

On page 4 of the Official Action, claims 12 - 13 and 16 - 17 were rejected under 35 USC 103(a) as unpatentable over JP 62-259665 in view of Gerstenberg (U.S. Patent No. 7,165,933). This rejection is respectfully traversed.

As discussed above with respect to claim 9, JP 62-259665 discloses a wave soldering apparatus having a single-blade screw

pump. There is no disclosure or suggestion in this reference concerning a multiple-blade screw pump.

Gerstenberg discloses a screw pump for transporting emulsions susceptible to mechanical handling. According to column 3, lines 65 - 67 of Gerstenberg, the number of blades in the screw pump is preferably in the range of 1 - 10, more preferably 1 - 6, and most preferably 2 - 5. The example shown in Figure 1 of Gerstenberg has two screw blades 11.

Column 5, lines 19 - 28 of Gerstenberg states that the screw pump is for the purpose of pumping any emulsion that is susceptible to mechanic or temperature damage and is particularly suited for pumping emulsions comprising oil or fat, water, and optionally a gas. Examples of such emulsions are dairy products, butter, margarine, margarine products, spread, mayonnaise, dressings, toppings, dough, creams, lotions, ointments, etc. Preferably the emulsion is a food.

According to page 5 of the Official Action, it would have been obvious from Gerstenberg to have modified JP 62-259665 to employ a screw pump with 4 helical blades with each blade extending around the hub by at least 120° between first and second ends of the blade as set forth in claim 12, or so as to have the parameters (the slope of the blades, the projecting length of the lower end of the impeller, or the clearance between a casing and impeller) set forth in claims 13, 16, and 17. Regarding the features set forth in claim 12, the Official Action appears to be relying on the fact that the disclosure of Gerstenberg includes the possibility of a screw pump having 4 or

more blades, and in the embodiment shown in Figure 1 of Gerstenberg, each helical blade 11 spirals around the shaft of a rotor 9 by at least 120°. Regarding the features set forth in claims 13, 16, and 17, the Official Action does not appear to actually rely on Gerstenberg and simply dismisses these features out of hand.

The problem with the reliance on Gerstenberg by the Official Action is that Gerstenberg relates to the handling of a totally different material (emulsions) from the material which is handled in JP 62-259665. JP 62-259665 relates to a wave soldering tank for handling molten solder, and there is nothing in Gerstenberg to suggest that the properties of a screw pump for handling emulsions are in any way applicable to a screw pump for handling molten solder. Molten solder in not an emulsion, and none of the considerations in Gerstenberg relating to an emulsion, i.e., the need to handle "in a gentle way without excessive influences of heat or pressure to the product" (column 2, lines 40 - 42) have any relevance to the handling of molten solder. As such, Gerstenberg is nonanalogous art with respect to JP 62-259665, and a person skilled in the art could not find any reason to combine JP 62-259665 and Gerstenberg in the manner proposed by the Official Action. As such, the Official Action has failed to set forth a reasonable basis for combining the references and accordingly has failed to set forth a *prima facie* case of obviousness. The rejection of claims 12 - 13 and 16 - 17 is therefore improper.

On page 6 of the Official Action, claims 9 - 17 were rejected under 35 USC 103(a) as unpatentable over JP 2-205257. This rejection is respectfully traversed.

As stated above, claim 9 describes a wave soldering tank having a multiple-blade screw-type pump. JP 2-205257 does not disclose or suggest such an arrangement.

JP 2-205257 discloses a wave soldering apparatus employing a flow pump 14 for sending molten solder to a nozzle 18 of a soldering tank 11. As clearly shown in Figure 2 of JP 2-205257, the pump 15 is a centrifugal flow pump having plate-shape blades. The soldering apparatus shown in this reference is thus similar to the prior art device shown in Figure 1 and described on page 1 of the present application. That apparatus therefore has the problems described on page 1 that the fluid discharged form the pump undulates.

Page 7 of the Official Action acknowledges that JP 2-205257 does not disclose the use of a screw-type pump, but the Official Action asserts that the invention of JP "inherently discloses the use of a screw type pump". It is not understood how the disclosure of a centrifugal pump inherently discloses a screw-type pump, given that a screw-type pump is not a category of centrifugal pump and is totally different in structure. The Official Action admits the possibility that there is no inherency, but goes on to assert that even if a screw-type pump is not inherent in the disclosure of JP 2-205257, the use of a screw-type pump would have been obvious "for substitutive predictable results".

This rejection relies upon a single reference which does not disclose or suggest the features present in the rejected claims. The rejection does not show where in the art those missing features are to be found, it does not provide any evidence that the missing features are mere substitutes for the structure employed in the reference or why a person skilled in the art would make a substitution, and it does not provide any evidence that the proposed modification of the single reference provides "predictable results". The rejection is therefore devoid of any objective showings as to why a person skilled in the art would find any reason to modify the single reference in manner proposed by the Official Action, and for this reason it does not provide any reasonable basis for the proposed modification. Accordingly, the rejection fails to set forth a *prima facie* case of obviousness and is defective. Claims 9 - 17 are therefore allowable.

On page 8 of the Official Action, claims 9 - 17 were rejected under 35 USC 103(a) as unpatentable over Ogawa (US 2004/0211816) in view of JP 62-259665. This rejection is respectfully traversed.

As set forth above, claim 9 describes a wave soldering tank having a multiple-blade screw-type pump. The cited references do not disclose or suggest such an arrangement.

Ogawa discloses a wave soldering apparatus which uses a centrifugal flow impeller pump. The apparatus of Ogawa is thus quite similar to and has the same problems as the device

disclosed by Patent Document 1, which is described on page 1 of the present application.

As described above, JP 62-259665 discloses a wave soldering apparatus equipped with a pump 5 having a single-blade helical screw 23.

According to the Official Action, it would have been obvious to have modified Ogawa to employ a multiple-blade screw pump because, according to the Official Action, a screw-type pump is an impeller pump.

The error in this rejection is that the combined references fail to teach all the features of the rejected claims. Regardless of whether a person skilled in the art could find any reason to modify Ogawa to use the helical screw 25 of JP 62-259665 in place of the impeller 44 of Ogawa, the proposed modification would not result in an arrangement having all the features set forth in independent claim 9. Claim 9 requires a multiple-blade screw pump, and as stated above, JP 62-259665 teaches a pump 15 having only a single-blade helical screw 23.

Accordingly, as neither of the cited references discloses or suggests a multiple-blade screw pump, they are lacking sufficient teachings for them to be combined so as to result in an arrangement having all the features set forth in claim 9. As such, the references cannot render claim 9 obvious. Claim 9 and claims 10 - 17 which depend from it are therefore allowable.

As described on pages 8 and 9 of the present application, a multiple-blade screw pump provides significant improvements over

a single-blade screw pump when used in a wave soldering tank. With a single-blade screw pump, molten solder discharged from the pump undergoes undulations when the pump is rotated at a low speed, and the undulations produce undesirable fluctuations in the height of a solder wave discharged from a nozzle. If the pump is rotated at a high speed in order to reduce the undulations, it becomes necessary to increase the strength of the impeller of the pump in order to prevent breakage, and a high rotational speed results in a large amount of solder being discharged from the impeller. This makes it difficult to perform fine adjustment of the height of the solder discharged from the nozzle, since at a high rotational speed of a screw-type pump, the responsiveness of the wave height to a change in pump rotational speed is low. This makes it difficult to apply a suitable amount of molten solder to an object being soldered.

On the other hand, with a screw-type pump having a plurality of blades, solder is more uniformly discharged from the pump without the occurrence of undulations, even at a low rotational speed. The ability to operate at a low rotational speed makes it possible to perform fine adjustment of the height of solder which is discharged from a nozzle of a wave soldering device and thereby makes it possible to accurately control the amount of molten solder applied to an object being soldered

Another advantage of a multiple-blade screw pump over a single-blade screw pump occurs when the rotational speed of the pump is varied. As discussed at the interview, in wave soldering, the height of a solder wave is sometimes varied during

soldering. This is particularly the case in so-called on-demand soldering, in which the height of a solder wave is minimized when no object is being soldered in order to reduce the rate of oxidation of molten solder, and then the height of the wave is increased only when an object to be soldered approaches or is disposed above the solder wave. After the object has been soldered, the height of the solder wave is again minimized. Raising and lowering the height of the solder wave is accomplished by raising and lowering the rotational speed of a pump producing the solder wave. Each time the rotational speed of a pump is raised, the height of the solder wave will fluctuate before stabilizing at the desired height. It is undesirable to pass an object to be soldered through a solder wave when the wave height is fluctuating, since a fluctuating wave height results in the amount of molten solder which is applied to the object being unpredictable. Therefore, it is desirable to wait until the wave height has stabilized before passing an object through a solder wave.

The present inventors found that when the rotational speed of a screw-type pump is changed in order to change the height of a solder wave, the height of the wave stabilizes much more quickly when using a multiple-blade screw pump than when using a single-blade screw pump. The more quickly the wave height stabilizes after a change in wave height, the less time it is necessary to wait until passing an object through the solder wave Accordingly, by using a multiple-blade screw pump which reduces the time required for the wave height to stabilize, the waiting

time can be reduced and the through-put of objects through the solder wave can be increased, resulting in an increase in the productivity of a wave soldering tank. None of the references relied upon in the Official Actions contain any suggestion of these advantages provided by a multiple-blade screw pump in a wave soldering tank.

Page 9 of the Official Action lists a number of references as being pertinent to the Applicants' disclosure and goes so far as to allege that certain references are anticipatory. Since the Official Action did not issue a formal rejection based on any of these references, there is no requirement that the Applicants describe the differences between these references and the claims. However, for the benefit of Examiner Mehta, who was not involved in the drafting of the Official Action, those references which are alleged to be anticipatory will be briefly mentioned.

Shigematsu (U.S. Patent No 5,301,862) discloses a solder coating apparatus for soldering of lead frames. This reference does not pertain to wave soldering. Although Figure 8 shows an embodiment having a screw pump, there is no disclosure or suggestion that it is a multiple-blade screw pump.

Nakagawa (JP 56-023371) discloses a soldering apparatus including a screw pump mechanism 5. There is no disclosure of the structure of the screw pump mechanism 5 and it is shown only schematically in the figures, so this reference does not disclose a multiple-blade screw pump.

Furthermore, Masuda (JP 58-013470 discloses a wave soldering

tank which employs a centrifugal pump 6 to pump molten solder into nozzles 12 containing stationary helical flow straightening plates 24. There is no disclosure of any screw-type pump.

Thus, none of Shigematsu, Nakagawa, or Masuda is in fact relevant to the disclosure of the present application.

Among the other references of record in the present application is JP 47-6024, which discloses an overflow dip tank. Figure 1 of that reference shows a dip flow tank containing a screw pump 3 which appears to have two helical blades. However, that reference does not appear to be related to a wave soldering tank, so it, too, is not relevant to the disclosure of the present application.

New claims 18 - 25 describe additional features of the present invention. Claims 18 and 19 are allowable as depending from claim 9. New claims 20 and 25 describe a wave soldering tank including a multiple-blade screw-type pump. As discussed above with respect to claim 9, none of the references relied upon in the rejection discloses the use of a multiple-blade screw-type pump in a wave soldering tank. Claim 20, claims 21 - 24 which depend from it, and claim 25 are thus allowable.

Of the new claims, new claim 24 states that there is no obstruction to flow of fluid between the first opening and the lower end of the nozzle, while new claim 25 states that a casing which surrounds an impeller fluidly communicates with the lower end of a nozzle along an unobstructed flow path. Claims 24 and 25 are supported by page 10 of the application as filed, which

state that flow straightening plates (which are typically needed in conventional wave soldering tanks to reduce undulations) are unnecessary with a wave soldering tank according to the present invention. Claims 24 and 25 are also supported by Figure 2(a) of the drawings, which shows an unobstructed flow path for molten solder between an opening in the partition 6 in which the impeller 14 is disposed and the lower end of the nozzle 11.

In light of the foregoing remarks, it is believed that the present application is in condition for allowance. Favorable consideration is respectfully requested.

Respectfully submitted,

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